Hydrogen Reclamation and Reutilization

By Bartt Hebert & John Lansaw, Stennis Space Center, Mississippi

John C. Stennis Space Center (SSC) provides rocket engine propulsion testing for NASA's space programs. Since the development of the Space Shuttle, every Space Shuttle Main Engine (SSME) has undergone acceptance testing at SSC before going to Kennedy Space Center (KSC) for integration into the Space Shuttle. The SSME is a large cryogenic rocket engine that uses Liquid Hydrogen (LH2) as the fuel. As NASA moves to the new ARES V launch system, the main engines on the new vehicle, as well as the upper stage engine, are currently base lined to be cryogenic rocket engines that will also use LH2. The main rocket engines for the ARES V will be larger than the SSME, while the upper stage engine will be approximately half that size. As a result, significant quantities of hydrogen will be required during the development, testing, and operation of these rocket engines.

Technology Needs

Testing of cryogenic rocket engines has made SSC one of the world's largest users of hydrogen. Currently, most of the LH2 is brought to SSC by trucks or barges. During propellant transfers from the trucks or barges as well as during storage and transfers when conducting test operations, huge amounts of LH2 are lost. Much of the loss is due to boiloff as the heat in the systems causes the LH2 to phase into gaseous hydrogen, which is vented to test facility flare stacks. Conservatively, approximately one half of the hydrogen bought for use in test programs is lost during these operations.

Liquid Hydrogen Propellant Barge docked at the A-2 Test Facility

The vast majority of this hydrogen boiloff is burned in the facility flare stacks as a safety precaution. The capability to reclaim and reutilize this hydrogen boiloff could offer potential savings of millions of dollars annually. The emerging hydrogen economy has

developed systems and technologies that could potentially make use of this lost hydrogen if methods were developed to recover at least a portion of the boiloff for reuse. A potential reutilization would require systems to capture, reclean, repressurize, and store this boiloff for reuse by the test facility. Options for the reuse of this reclaimed hydrogen could be as GH2 in the test facility or potentially even other alternate energy uses.

Innovative solutions are needed for efficient, cost effective, in-situ methods to recapture, reclean, repressurize, and store hydrogen boiloff for reuse. Research into technologies in these areas, demonstration of the technology capability, and conceptual design for the technology installation at Stennis are desired to assist in the hydrogen recovery and reuse.

Hydrogen Flare Stacks for A2 Test Stand

Technology Challenges

The primary challenge will be to safely capture, process, and store the large amounts of gaseous hydrogen released during test operations. Gaseous hydrogen used in rocket engine test operations must meet very specific cleanliness standards. Another challenge will be to develop an on-site system capable of recycling the captured hydrogen to the cleanliness standards requirements. An additional challenge will be to determine the appropriate utilization of the recaptured hydrogen for test operations or alternative energy uses.

The technologies developed to capture and clean the hydrogen must be cost effective and able to perform the recycling process in an in-situ rocket engine test area environment. It will be required to comply with all safety and quality standards required in this environment.

More Information

For additional information, or to discuss ideas about this concept, contact John Lansaw at Stennis Space Center, Mississippi, 228-688-1962 or john.lansaw-1@nasa.gov